FINAL REPORT

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"Optical Surface Damage From Reentrant Gases On STS"

Prepared for:

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Introduction

In the space shuttle flights many of the experiments will have optical surfaces. These surfaces will be exposed to the various chemical atmospheres surrounding the space shuttle and the effects on the reflectivity of the surfaces is uncertain. The purpose of this study was to determine the effect, if any, on the spectral reflectance of certain optical surfaces in the vacuum ultraviolet region (1200 -2000Å) in an ammonia environment.

Experimental

Since the spectral region of interest was 1200-2000Å, all of the reflectance studies had to be performed under vacuum. A Jarrell-Ash 1 meter vacuum ultraviolet scanning spectrometer was used to scan the emission from a hydrogen discharge lamp. The beam from the monochromator was first passed through a MgF_2 window. This window mounted at a 45° angle was used as a beam splitter. The reflected beam was the reference beam and was monitored by the use of a sodium salicylate coated window and a photomultiplier tube. The other beam was reflected by the sample mirror mounted at 45° into a sodium salicylate coated window and photomultiplier. The photomultiplier tubes used were EMI model no. 9635B (See Figure 1).

The signals from the two beams were adjusted to be approximately equal by using different voltages and mask. The difference between the two signals was then obtained by using either a Tektronics Type O Amplifier or a Tektronics Type 1A7A Differential Amplifier. This signal was then recorded on a strip chart recorder.

Two types of mirror samples were obtained from Newport Research Corporation. The first was 1000Å of Al overcoated with 250Å MgF_2 on a quartz blank. The other was a Cr coated quartz blank overcoated with 250Å of Pt. Because of its higher reflectance in the vacuum ultraviolet, the Al coated mirror was chosen as the main one for study. It was felt that if any effects were observed on the Al mirrors then the Pt coated mirrors could be checked.

After a sample had been aligned with a Helium-Neon laser, the system was evacuated. Several scans of the spectrum from 1400Å to 2000Å were then recorded. The region from 1200Å to 1400Å was excluded because of the weak intensity observed from the hydrogen lamp in this spectral region. In addition to a fairly large black-body signal, a drift in the difference signal occurred over a period of time. To help compensate for this drift, the background signal was always adjusted to 50% on the chart recorder before each scan. Also several scans were run. After the reflectance signal from a clean sample was obtained, the sample chamber was closed off and 100 torr of ammonia was admitted. After this pressure was maintained for various lengths of time, the chamber was evacuated and the reflectance recorded.

Results

A typical signal obtained from the sample beam photomultiplier is shown in Figure 2. Scans made of the sample beam before and after exposure to ammonia showed no change in the relative intensities. The results of the experiment with the longest ammonia exposure time on a Al/MgF_2 mirror is shown in Figure 3. Each scan shown is the difference signal from the sample and reference beam. The deviation from zero is the result of the sample signal having been initially adjusted to be larger than the reference signal. Scan A is the before exposure signal. Scan B was obtained after the sample was exposed to 100 torr of ammonia for 4 hours. Scan C is the result obtained after an additional 16 hours of exposure. The differences observed between the exposed and unexposed samples were all within experimental error. It, therefore, appears that ammonia has no effect on the Al/MgF_2 reflectance in the vacuum ultraviolet. Since small effect could not be detected in our experimental set-up, much longer exposure times need to be performed before any definite conculsions could be reached. As time permits these and other experiments will be performed and any results different from the one reported here will be forwarded as a supplementary report.

Acknowledgements

I wish to acknowledge the assistance of Terry Whitt and Tommy Smith in the assembling of the equipment and running of the experiment. I am indebted to Dr. Gary Workman for valued technical advise. I alsc wish to thank Mrs. Pat Craig for typing this report.

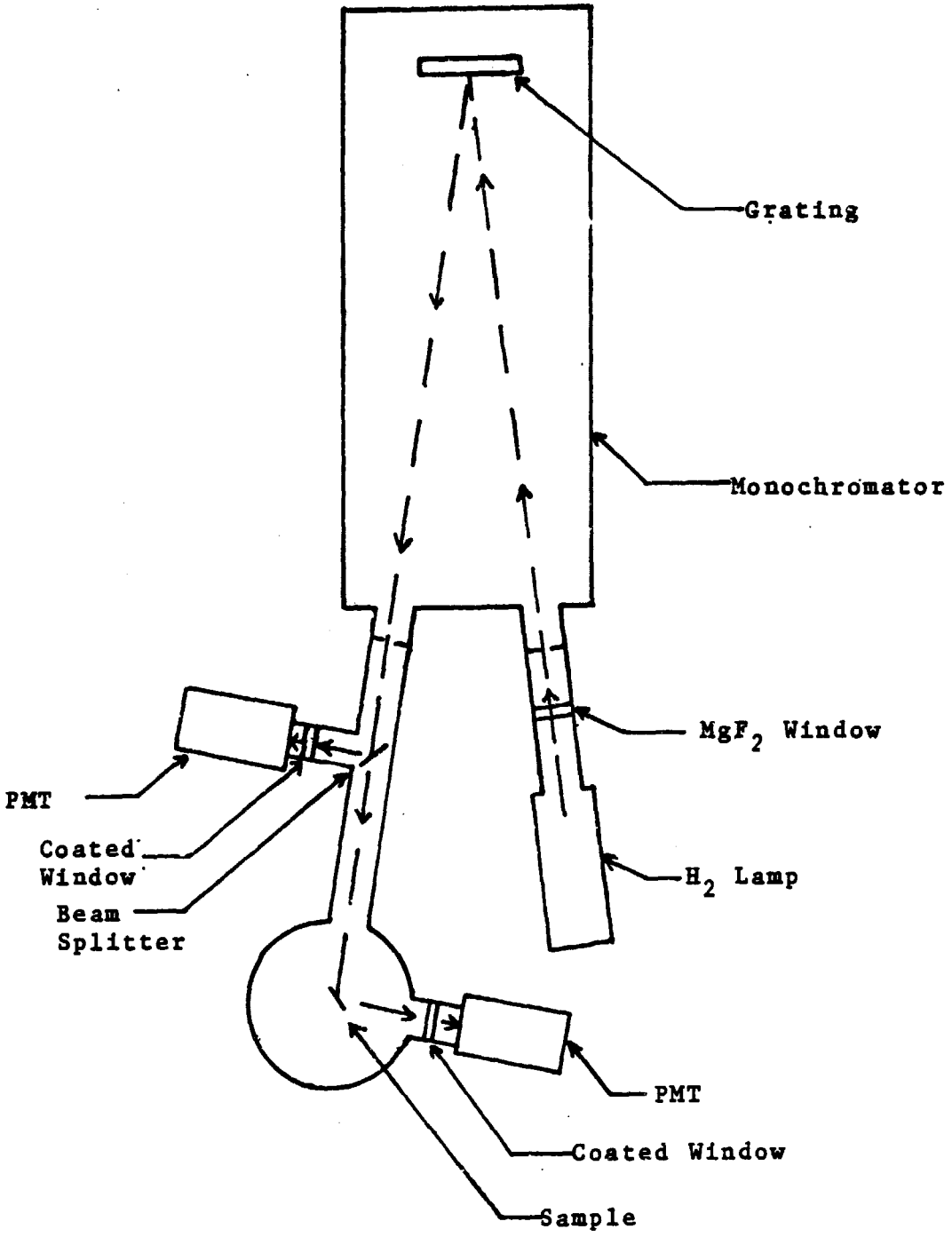

Figure 1: Schematic Of Experimental Apparatus

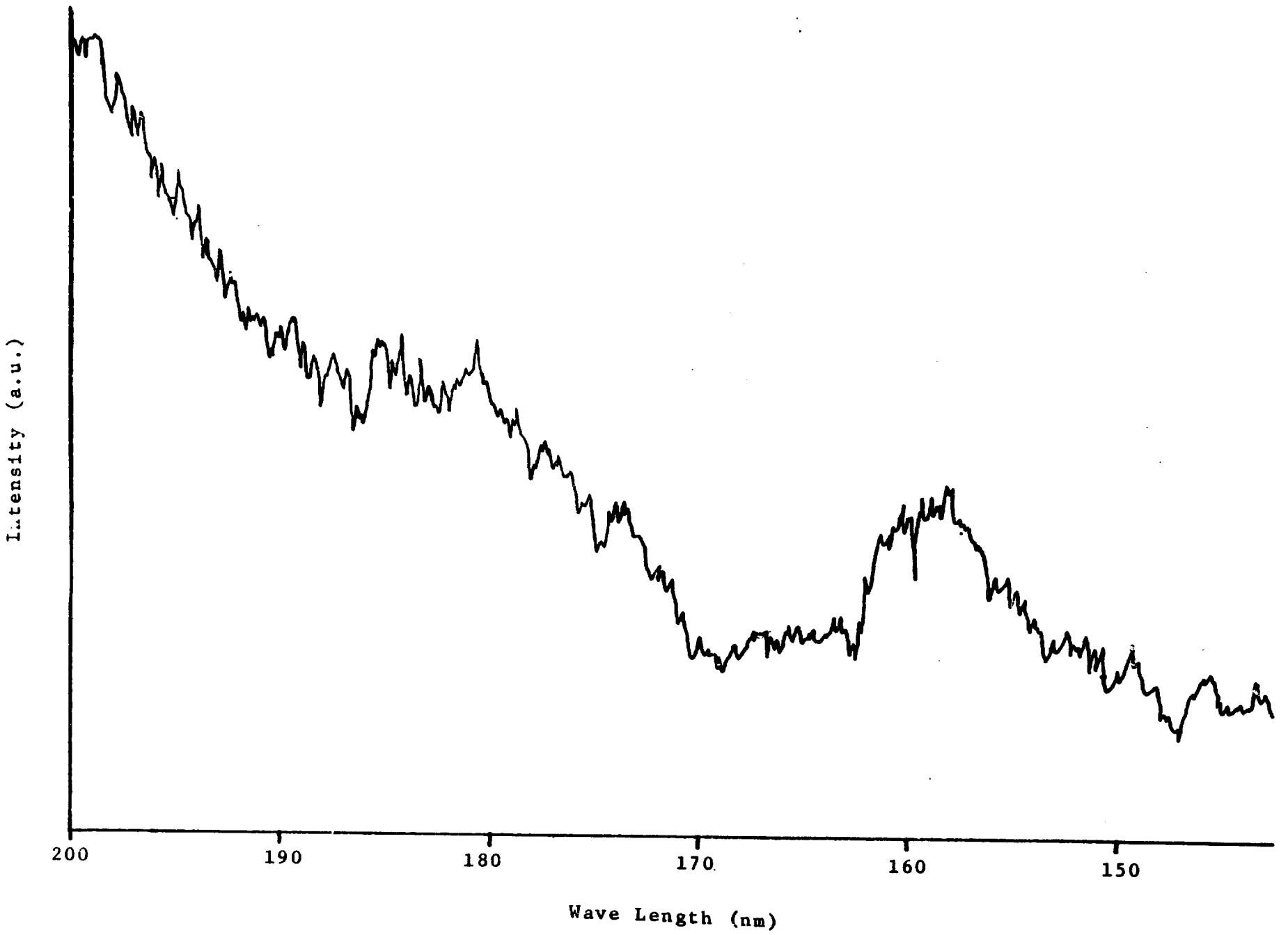

Figure 2: Typical Hydrogen Spectra

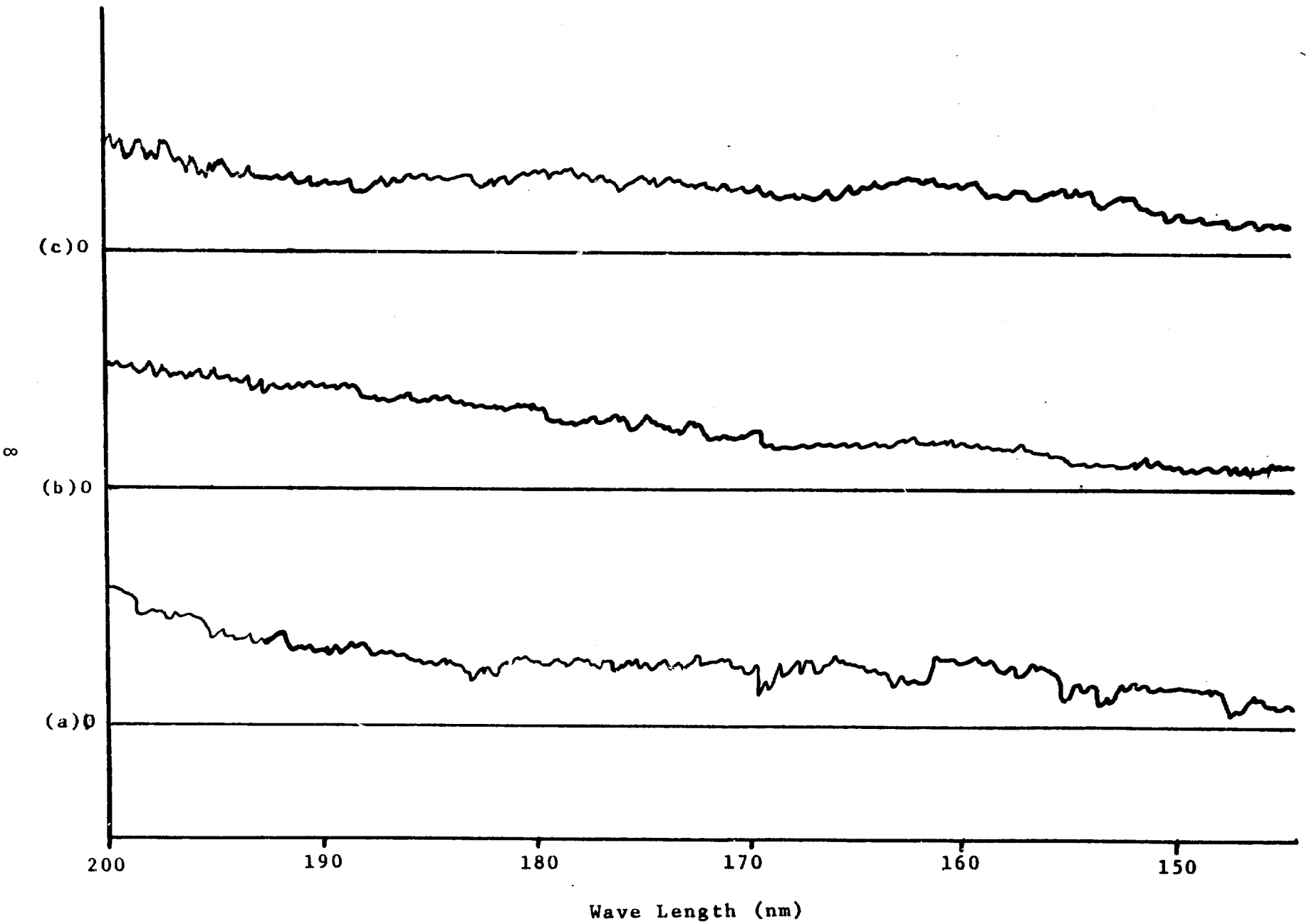

Figure 3: Typical Difference Spectra Of Before And After NH_3 Contamination